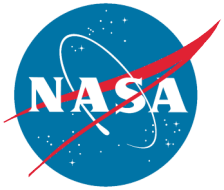
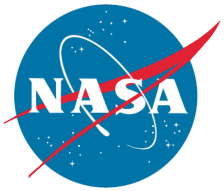


Breakout Session Summary:

Materials

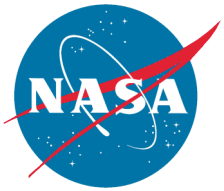
Chair: Ram Tripathi (NASA LaRC)
Co-chair: Gary Pippin (Boeing)

SET-3 Requirements Workshop
March 29-30, 2007



Background

- **Approach to the review process**
- **Explicitly considered solar variability as parameter for each materials-related topic**
  - **General issues discussed about space “data mining”**
  - **General shortcomings of current models, protocols or data bases**



Prioritized Materials Topics

- **Topics were non-specific to any particular investigator or organization**
- **Topics were individually ranked by group consensus**
- **Main concerns are degradation of materials and shielding performance and how those are affected by solar activity**

Technology Breakout Session (Check One):

__ **Environment Specification**
__ **Microelectronics** _x_ **Materials**
__ **Sensors & Detectors** __ **Charging/Discharging**

Title of Issue Requiring Investigation:

Secondary Particle Radiation Effects

Background:
Variation of internal radiation environment as a function of shield materials, with focus on materials other than aluminum

Description of Needed Investigation:
Study effects of particle energy, type and composition of material, thickness of material. Provide predictive model.

Justification:
Ambient energy spectrum and, therefore, induced secondary radiation is directly related to solar variability. That can be easily monitored by exposure levels and used to determine the thresholds to humans and electronics

Benefiting Technology Areas:
Electronic payloads, human shielding

Benefiting Space Application Areas:
All spacecraft

Investigation Resource Requirements:

Data Access Requirements (data name, cost):

Investigation Cost to LWS SET:

Investigation Cost-Sharing Contribution:

Date for Final Deliverables:

Submitter Information:

Name:

Phone:

E-mail:

Organization:

Technology Breakout Session (Check One):

__ **Environment Specification**
__ **Microelectronics** _x_ **Materials**
__ **Sensors & Detectors** __ **Charging/Discharging**

Title of Issue Requiring Investigation:

Design Data

Background:
Eliminate the need to "reinvent the wheel."

Description of Needed Investigation:
Capture existing flight data or extract design lessons from previous missions. Document successful uses of materials. Develop databases and knowledgebases so that data is available in a manner that design engineers can use.

Justification:
Make design engineers aware of potential environment issues in the preliminary design stage when costs can be minimized.

Benefiting Technology Areas:
Materials selection, thermal control design, structural design, risk mitigation

Benefiting Space Application Areas:
All spacecraft, habitat and mobile structures

Investigation Resource Requirements:

Data Access Requirements (data name, cost):

Investigation Cost to LWS SET:

Investigation Cost-Sharing Contribution:

Date for Final Deliverables:

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Technology Breakout Session (Check One):

__ **Environment Specification**
__ **Microelectronics** _x_ **Materials**
__ **Sensors & Detectors** __ **Charging/Discharging**

Title of Issue Requiring Investigation:

Radiation Transport Codes for Ionizing Radiation

Background:
Several Monte Carlo and deterministic transport codes exist for ionizing radiation. There is not agreement between these codes. There is a need to develop a "trustworthy", reliable code for radiation exposure and electronics damage studies

Description of Needed Investigation:
Using verification, validation, and uncertainty quantification, compare all codes and identify the accuracy and reliability of the codes.

Justification:
Benchmarking various 3-D Monte Carlo and deterministic codes to reduce uncertainties in radiation transport simulations.

Benefiting Technology Areas:
Electronic payloads, human shielding

Benefiting Space Application Areas:
All spacecraft

Investigation Resource Requirements:

Data Access Requirements (data name, cost):

Investigation Cost to LWS SET:

Investigation Cost-Sharing Contribution:

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Technology Breakout Session (Check One):

__ **Environment Specification**
__ **Microelectronics** _x_ **Materials**
__ **Sensors & Detectors** __ **Charging/Discharging**

Title of Issue Requiring Investigation:

Uncertainty of Ambient and Internal Radiation Environments

Background:
Mission risks are dependent on uncertainty values, and budgetary and flight protocol decisions are made based on risks and uncertainties.

Description of Needed Investigation:
Evaluation of existing data sets to improve the ambient environment predictions and better understand the uncertainties.

Justification:
Uncertainty in the internal environment is enhanced by the production of secondary particles and the uncertainty in the ambient environment.

Benefiting Technology Areas:
Electronic payloads, human shielding

Benefiting Space Application Areas:
All spacecraft

Investigation Resource Requirements:

Data Access Requirements (data name, cost):

Investigation Cost to LWS SET:

Investigation Cost-Sharing Contribution:

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Technology Breakout Session (Check One):

__ **Environment Specification**
__ **Microelectronics** _x_ **Materials**
__ **Sensors & Detectors** __ **Charging/Discharging**

Title of Issue Requiring Investigation:

Improved Neutral Atmospheric Model

Background:
The current models, MSIS-86 and MET, have uncertainty in the neutral density, which leads to further uncertainty in atomic oxygen fluence and drag calculations, particularly over the solar cycle. Neutral density is a strong function of the solar cycle.

Description of Needed Investigation:
Data mining of recent spectroscopic measurements in LEO can be used to improve the existing model. Recent flight experiments can also provide data on atomic oxygen erosion.

Justification:
The physics of the neutral atmosphere are understood, more information is needed on absolute number densities.

Benefiting Technology Areas:
Satellite performance, risk mitigation

Benefiting Space Application Areas:
Spacecraft flying in or through LEO

Investigation Resource Requirements:

Data Access Requirements (data name, cost):

Investigation Cost to LWS SET:

Investigation Cost-Sharing Contribution:

Date for Final Deliverables:

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Technology Breakout Session (Check One):

__ **Environment Specification**
__ **Microelectronics** _x_ **Materials**
__ **Sensors & Detectors** __ **Charging/Discharging**

Title of Issue Requiring Investigation:

Data Mining of Ground-Based Irradiation Tests

Background:
The nuclear industry, nuclear medicine, and the American Society of Civil Engineers have information on radiation effects on materials.

Description of Needed Investigation:
Correlate ground test results from radiation tests with actual exposures with the on-orbit ionizing radiation spectra. Exploit and analyze previous ground test results (e.g. basic nuclear physics, transport, and material properties data)

Justification:
Model validation and material selection criteria will benefit from this effort.

Benefiting Technology Areas:
Radiation shielding, structural properties

Benefiting Space Application Areas:
All spacecraft

Investigation Resource Requirements:

Data Access Requirements (data name, cost):

Investigation Cost to LWS SET:

Investigation Cost-Sharing Contribution:

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Technology Breakout Session (Check One):

__ **Environment Specification**
__ **Microelectronics** _x_ **Materials**
__ **Sensors & Detectors** __ **Charging/Discharging**

Title of Issue Requiring Investigation:

Data Mining of Long Term Spacecraft Imagery

Background:
Several spacecraft have had photographic surveys performed. Space environmental effects on materials can be inferred from darkening, peeling, cracking, and other visible degradation.

Description of Needed Investigation:
Analyze images from long term spacecraft, including the International Space Station, Hubble Space Telescope, Mir, Solar Max, Skylab. Determine effects from contamination, ultraviolet radiation, and atomic oxygen.

Justification:
Use of existing data for risk mitigation and lessons learned from previously flown spacecraft.

Benefiting Technology Areas:
Thermal control systems

Benefiting Space Application Areas:
All spacecraft

Investigation Resource Requirements:

Data Access Requirements (data name, cost):

Investigation Cost to LWS SET:

Investigation Cost-Sharing Contribution:

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Technology Breakout Session (Check One):

__ **Environment Specification**
__ **Microelectronics** _x_ **Materials**
__ **Sensors & Detectors** __ **Charging/Discharging**

Title of Issue Requiring Investigation:

Analysis of Solar Array Performance Data

Background:
Data exists on spacecraft solar array performance, usually basic power curves, but is not correlated by design or environment.

Description of Needed Investigation:
Relate solar array performance to flight duration, environmental exposure levels, and orbit. Performance of materials to include coverglass, anti-reflectance coatings, power output, spacecraft charging, real-time performance, and array design including contacts, diodes, and backing material.

Justification:
Use lessons learned from previously flown solar arrays for risk mitigation.

Benefiting Technology Areas:
Power systems

Benefiting Space Application Areas:
All spacecraft with solar arrays

Investigation Resource Requirements:

Data Access Requirements (data name, cost):

Investigation Cost to LWS SET:

Investigation Cost-Sharing Contribution:

Date for Final Deliverables:

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Organization:

Materials Summary

1. Secondary Particle Radiation Effects
2. Design Data
3. Radiation Transport Codes for Ionizing Radiation
4. Uncertainty of Ambient and Internal Radiation Environments
4. Improved Neutral Atmospheric Model
4. Data Mining of Ground-based Irradiation Tests
5. Data Mining of Long Term Spacecraft Imagery
5. Analysis of Solar Array Performance Data